Uniaxial die compaction of food powders

Abstract

This paper presents a study of uniaxial die compaction of food powders for typical food powders such as maize powder and maize grits as well as a universal binder known as microcrystalline cellulose or Avicel. This method of compaction is widely applied in the industry as it can investigate the compressibility and compactability characteristics of powders prior to handling, storage, packaging, and transportation. In the current context, a cylindrical uniaxial die of 20 mm was used to compress the powders into compact. Pressures ranging of 30 and 160 MPa were applied to the uniaxial die using a universal testing machine. It was found that Avicel powder showed the highest compactability characteristic, ability to form bonding easily. Whereas, compactability of both the coarse maize and fine maize were quite similar, which may be due to the similar chemical composition. The data were then validated using an established compression equation. The asymptotic residual modulus value reduced as the ability of the food powders to form plastic junctions - assuming that they existed - increased. For the tensile strength test, Avicel compact showed the greatest tensile strength, many times that of fine maize and coarse maize compacts. However, between the fine maize and coarse maize, fine maize had higher tensile strength which may be due to its smaller particle size, as well as the fact that the contact area may be increased, and consequently may form a more coherent compact. The results indicate that this simple approach can be used to understand the compressibility and compactability characteristics of food powders which are essential for engineering and technology application.

Keyword: Compactability; Compressibility; Food powders; Stress relaxation; Tensile strength; Uniaxial die